

DIOXIN LEVELS IN PIGEON RIVER FISH

1996 - 2002



Tennessee Department of Environment and Conservation
Division of Water Pollution Control
7th Floor L&C Annex
401 Church Street
Nashville, TN 37243-1534

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Prepared by

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EXECUTIVE SUMMARY

In April 1989, the State of Tennessee issued a “do not consume” advisory on all fish in the Pigeon River due to dioxin contamination. The advisory covered the river from the North Carolina-Tennessee state-line downstream to the mouth on the French Broad River (Douglas Reservoir). Dioxin levels in fish tissue samples exceeded the 5 part per trillion (ppt) posting trigger. The source of the contamination was the Champion Paper Mill in Canton, North Carolina. Since that time, the paper mill has changed ownership (Blue Ridge Paper). Since the original advisory was posted, the plant has improved pollution control practices.

Fish tissue data collected between 1989 and 1995 demonstrated a drop in dioxin contamination with some species exhibiting safe levels. In March 1996, the advisory for the Tennessee portion of the river was downgraded to a “precautionary advisory” for redbreast sunfish, carp and catfish.

Fish tissue samples have continued to be collected at three sites on the Pigeon River over the last seven years. The three species on the advisory, as well as additional game and rough fish species, have been analyzed for dioxin. Game fish and rough fish have consistently been below 1 ppt. Catfish are generally higher but consistently fall below 2 ppt. None of the fish samples has exceeded the 5 ppt advisory level during this period.



One of the original Pigeon River fish consumption advisory signs near Waterville. (Photo by Greg Denton)

Based on the data collected since 1996, it appears that the fish in the Pigeon River are safe to eat at normal consumption rates. The Division of Water Pollution Control is recommending that the Tennessee segment of the river be de-posted for fish consumption. North Carolina, which has a dioxin posting limit of 3 ppt, removed their consumption advisory on the Pigeon River in August 2001.

INTRODUCTION

The Pigeon River enters Cocke County in Tennessee from North Carolina around river mile 26. The river meanders northwest and enters the French Broad River (Douglas Reservoir) near Rankin.

The Pigeon River is impounded upstream of the state-line to form Waterville Reservoir. Water from this reservoir is diverted downstream to a powerhouse to produce electricity. The dam is thought to provide an important barrier to the transport of contaminated sediment downstream.

The major discharge into the Pigeon River is from the Blue Ridge Paper Company (formerly Champion) near Canton, North Carolina. Dioxin is the primary pollutant of concern for consumption of fish.

Dioxins are a group of synthetic organic chemicals that contain 210 structurally related individual chlorinated dibenzo-p-dioxins (CDDs) and chlorinated dibenzofurans (CDFs). Dioxin is a generic term that is used to refer to the aggregate of all CDDs and CDFs. Evidence suggests that dioxins may cause cancer in humans (EPA, November 2000). Additionally, dioxin is a potent toxicant at low concentrations. Children are considered more susceptible than adults are and the developing reproductive, immune and nervous systems of fetuses are probably sensitive to dioxin toxicity. Dioxins bioaccumulate in the fatty tissue of fish.

In April 1989, the State of Tennessee issued a “do not consume” fishing advisory on all fish in the Pigeon River due to dioxin contamination. In March 1996, the advisory was downgraded to a “precautionary advisory” for redbreast sunfish, carp and catfish. A precautionary advisory recommends that children, pregnant women and nursing mothers avoid consumption of the specified fish while all other persons should limit consumption of the named species to one meal per month. The advisory covers the Tennessee portion of the river from the state line to the mouth.

The fish tissue advisory posting level for dioxin in North Carolina is 3 ppt. An advisory on all fish downstream of the paper mill was enacted by the North Carolina Health Director in 1988. Following implementation of improved pollution controls at the paper mill, the advisory was reduced in 1994 to include only carp and catfish. The fish consumption advisory on the Pigeon River in North Carolina was completely lifted in August 2001 (NC DHHS, 2001).

WATER QUALITY CRITERION FOR DIOXIN

The original advisory for dioxin in Pigeon River fish was issued before the Water Quality Control Board had completed promulgation of the existing one part per quadrillion (ppq) dioxin water criteria. This criterion, unlike all other Tennessee clean water goals for priority pollutants, is not based on the national guidance provided by the Environmental Protection Agency (EPA). Instead, an independent analysis that blended both EPA and U.S. Food and Drug Administration (FDA) assumptions was undertaken. After Tennessee made modifications in its original rationale, EPA approved the proposed 1 ppq criterion as based on acceptable science.

The derivation of the fish tissue posting level for dioxin was generally based on the water criterion. The 1 ppq water criterion was multiplied times the accepted bioconcentration factor for dioxin at that time, 5000. Thus, it was determined that if fish tissue levels did not exceed 5 parts per trillion (ppt), the dioxin water quality standard was not exceeded.

For the last ten years, EPA has been working on a reassessment of dioxin. The major draft finding of this reassessment is that while the potency of dioxin should be slightly adjusted, the original criterion basis was generally sound. Additionally, the FDA communicated a policy decision that advised states that the assumptions used in the development of FDA screening levels are not a proper basis for water criteria or for the determination of the need for localized fish consumption advisories.



The Pigeon River near Newport, Tennessee.
(Photo by Jonathon Burr, Knoxville EAC)

When the EPA formal reassessment is published in final form, Tennessee will likely recognize the document as the best science available on this subject and move to modify the existing dioxin water criterion. The reassessment findings combined with the existing risk assessment procedure would yield a fish criterion posting number for dioxin of 1.2 part per trillion. However, 1.2 is not currently Tennessee’s dioxin posting/deposting level. After 10 years of research and discussion, EPA has not published a final dioxin guidance document. Therefore, Tennessee’s 5.0 ppt fish posting level remains in effect.

DATA COLLECTION

This report includes all data collected after 1995. Earlier data were presented in a study by Freeman and Denton in 1997. Data from other commonly encountered fish as well as the three species listed on the advisory (redbreast sunfish, carp and channel catfish) are presented in this document (Table 1).

Table 1: Fish species collected for dioxin analysis in the Pigeon River 1996 – 2002

Classification	Species	Advisory	Year Collected (Post 1995)
Game Fish	Redbreast Sunfish	Yes	1997
Game Fish	Spotted Bass	No	1997
Game Fish	Smallmouth Bass	No	1997, 1998, 1999, 2000, 2001
Game Fish	Rock Bass	No	1997, 1998, 1999, 2000, 2001
Game Fish	Largemouth Bass	No	1998
Rough Fish	Carp	Yes	1997, 1998, 2001
Rough Fish	Smallmouth Buffalo	No	1996, 1997, 1998, 1999
Rough Fish	Northern Hogsucker	No	1996, 1997, 1998, 1999, 2000
Rough Fish	Black Redhorse	No	2000, 2001
Catfish	Channel Catfish	Yes	1997, 1998, 2002

Fish tissue samples were collected from the Tennessee reach of the Pigeon River at three stations (Figure 1). The stations from upstream to downstream are:

- a. Bluffton
- b. Denton
- c. Tannery Island (just upstream of Newport)

The Bluffton site was collected by the Blue Ridge Paper Company. Other stations were collected by a cooperative effort between Water Pollution Control, the Tennessee Wildlife Resources Agency (TWRA) and the Tennessee Valley Authority (TVA).

A fourth station is located at Waterville, immediately downstream of the Tennessee/North Carolina state line. However, fish have not been collected at this location since 1995. At that time the fish sampled, rock bass, redbreast sunfish and northern hogsucker, all had dioxin levels well below 5 ppt with the highest value being 0.24 ppt.

Although channel catfish are represented in the Pigeon River fishing advisory, the Division and its partner agencies have historically had difficulty collecting this species for analysis, especially at the stations upstream of Newport. This species is not considered common in the Pigeon.

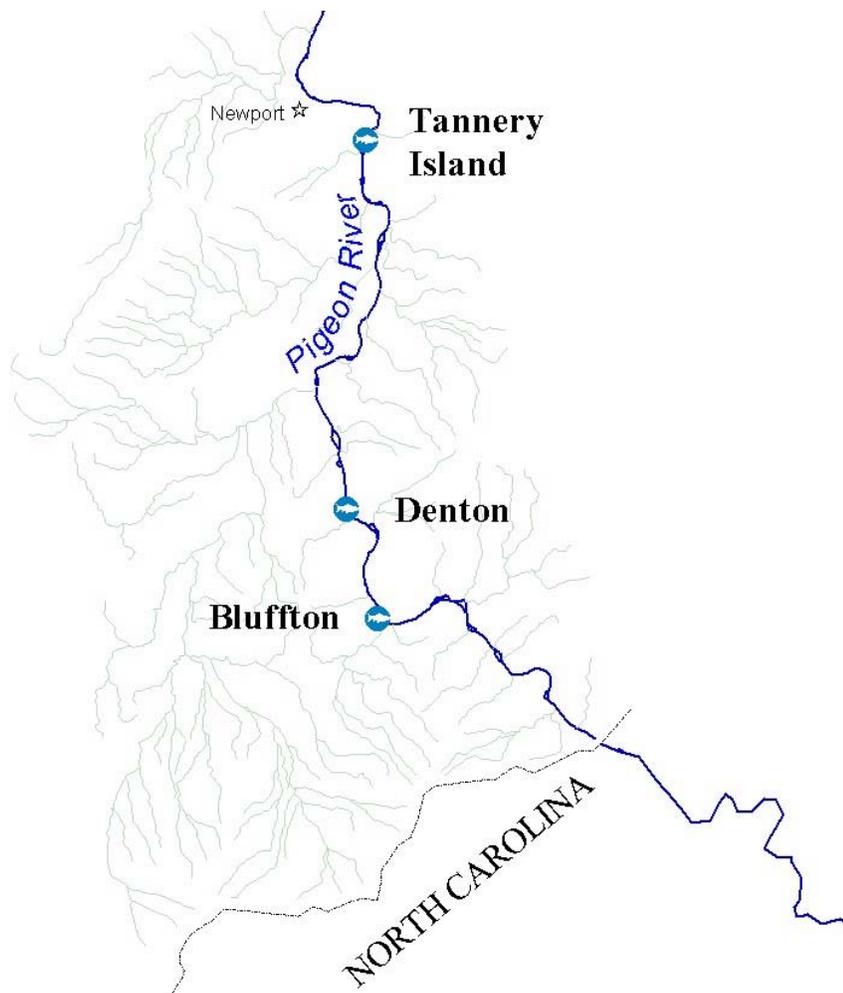


Figure 1: Fish Tissue Monitoring Stations on the Pigeon River

DATA ANALYSIS

The part of the fish most likely to be consumed was analyzed consistent with the procedure identified in Tennessee's General Water Criteria stream posting decisions (TDEC, 1999). Fillets included the belly flap. Game fish were scaled with skin left on. Rough fish and catfish were skinned. Samples consisted of both composited and individual fish. Dioxin samples were analyzed by Severn Trent Laboratory in California, Wright State University in Ohio, and TOXMED reference laboratory in Nashville.

The dioxin levels (ppt) reported in this document are the total equivalent concentration value. The total equivalent concentration of a sample is based on the sum of the concentrations of the individual dioxin and furan groups multiplied by a toxic equivalent factor (TEF). Consistent with EPA guidance, one half of the detection level was included for nondetected dioxin and furan groups for all samples.

RESULTS

Bluffton

Bluffton is the furthest upstream station on the Tennessee reach of the river. All samples were collected by Blue Ridge Paper Company (formerly Champion Paper). Samples were composites of five fish. All samples were fillets, except the Northern Hogsucker where the whole body was processed. Bluffton fish samples collected since 1996 have not had dioxin readings above 0.8 ppt (Figure 2 and Table 2). However, none of the advisory species were collected during this period including catfish, which typically have the highest dioxin readings.

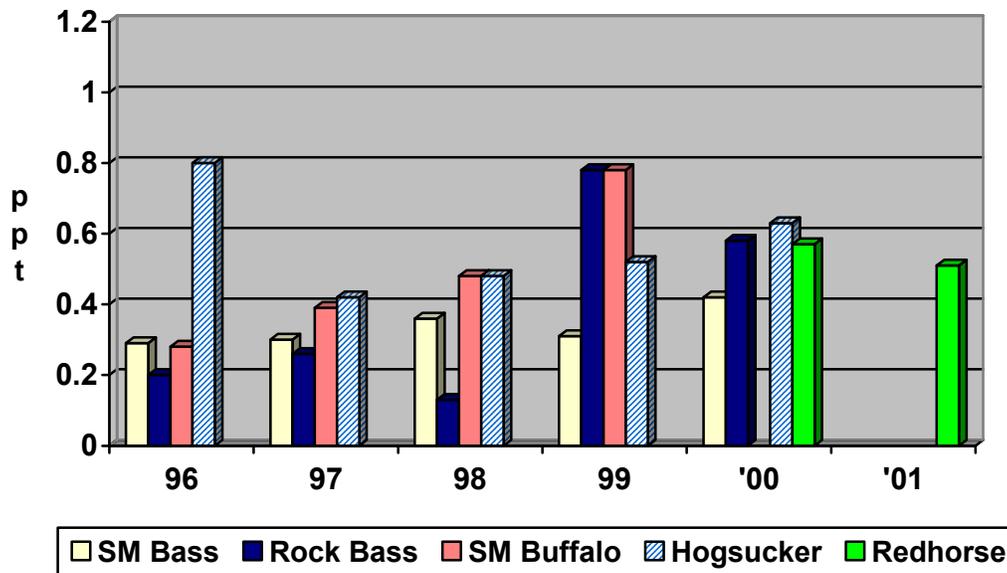
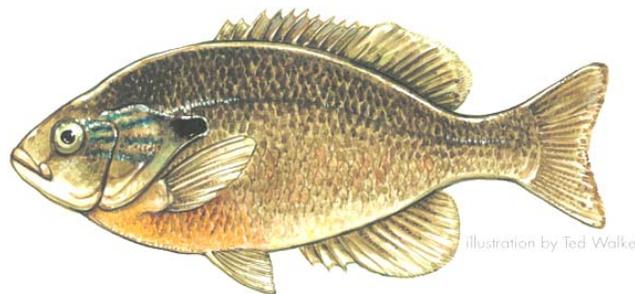


Figure 2: Fish tissue dioxin data from the Pigeon River at Bluffton (1996-2001). Chart represents the highest dioxin value found in each species.

Table 2: Fish tissue dioxin data from the Pigeon River at Bluffton (1996-2001)

Year Collected	Species	Number of Fish	Average Weight (lb)	Dioxin (ppt)	Fish Advisory
1996	Northern Hogsucker	5	0.9	0.80	No
1996	Rock Bass	5	0.2	0.20	No
1996	Smallmouth Bass	5	1.7	0.29	No
1996	Smallmouth Buffalo	5	3.9	0.28	No
1997	Northern Hogsucker	5	1.1	0.42	No
1997	Rock Bass	5	0.2	0.26	No
1997	Smallmouth Bass	5	0.9	0.30	No
1997	Smallmouth Buffalo	5	3.2	0.39	No
1998	Northern Hogsucker	5	0.8	0.48	No
1998	Rock Bass	5	0.2	0.13	No
1998	Smallmouth Bass	5	1.0	0.36	No
1998	Smallmouth Buffalo	5	4.0	0.48	No
1999	Northern Hogsucker	5	0.7	0.52	No
1999	Rock Bass	5	0.3	0.78	No
1999	Smallmouth Bass	5	1.8	0.31	No
1999	Smallmouth Buffalo	5	4.0	0.78	No
2000	Black Redhorse	5	2.3	0.57	No
2000	Northern Hogsucker	5	1.0	0.63	No
2000	Rock Bass	5	0.2	0.58	No
2000	Smallmouth Bass	5	0.7	0.42	No
2001	Black Redhorse	5	2.6	0.51	No



Redbreast Sunfish

Denton

The Denton station has only been sampled twice during this period (1997 and 1998). All samples were below the 5.0 ppt advisory level (Figure 3 and Table 3). In 1997 catfish were above 1.2 ppt but had dropped to 0.81 ppt in 1998. However, the 1997 value was based on analysis of individual fish that ranged in dioxin levels from 1.07 to 1.87. The 1998 result was based on a five-fish composite.

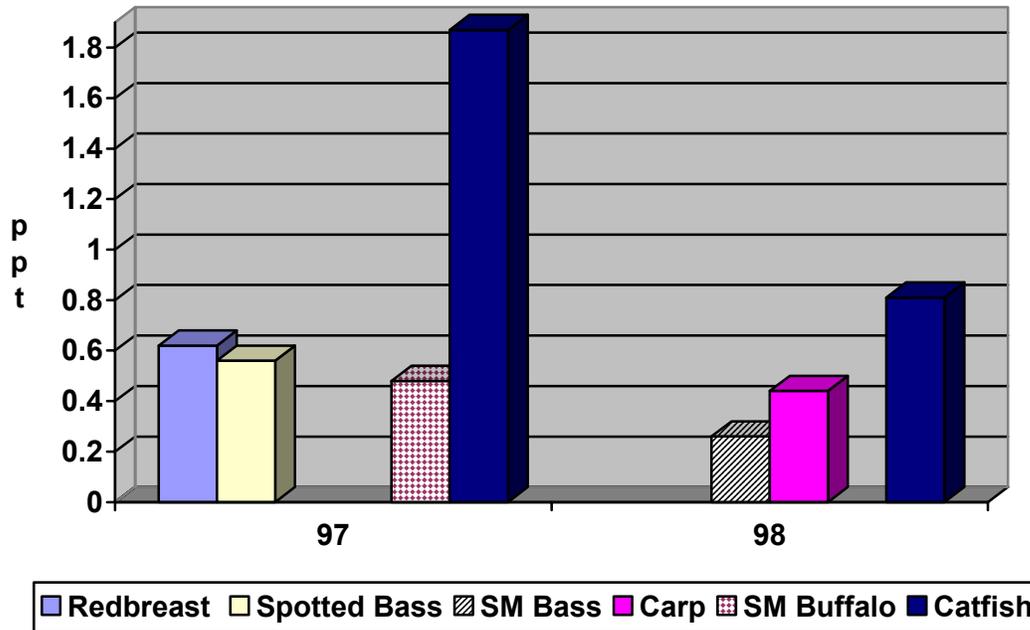


Figure 3: Fish tissue dioxin data from the Pigeon River at Denton (1997-1998). Chart represents the highest dioxin value found in each species.

Table 3: Fish tissue dioxin data from the Pigeon River at Denton (1997-1998)

Year Collected	Species	Number of Fish	Average Weight (lb)	Dioxin (ppt)	Fish Advisory
1997	Channel Catfish	1	3.4	1.87	Yes
1997	Channel Catfish	1	0.6	1.07	Yes
1997	Channel Catfish	1	3.9	1.09	Yes
1997	Smallmouth Buffalo	4	3.3	0.29	No
1997	Smallmouth Buffalo	1	6.4	0.48	No
1997	Spotted Bass	1	1.1	0.42	No
1997	Spotted Bass	4	0.5	0.56	No
1997	Redbreast Sunfish	5	0.4	0.62	Yes
1998	Channel Catfish	2	2.4	0.81	Yes
1998	Carp	4	5.5	0.44	Yes
1998	Smallmouth Bass	5	1.9	0.26	No

Tannery Island

Tannery Island is the farthest downstream station on the Pigeon River and is located just upstream of the city of Newport. All fish collected at this site since 1997 were well below the 5.0 ppt advisory limit (Figure 4 and Table 4). Catfish remain above 1.2 ppt but have dropped below 2 ppt since 1995 (Freeman and Denton, 1997). Carp have consistently had dioxin levels less than 1.0 ppt since 1998. Redbreast sunfish have not been collected since 1997, but were well below 1.0 ppt at that time.

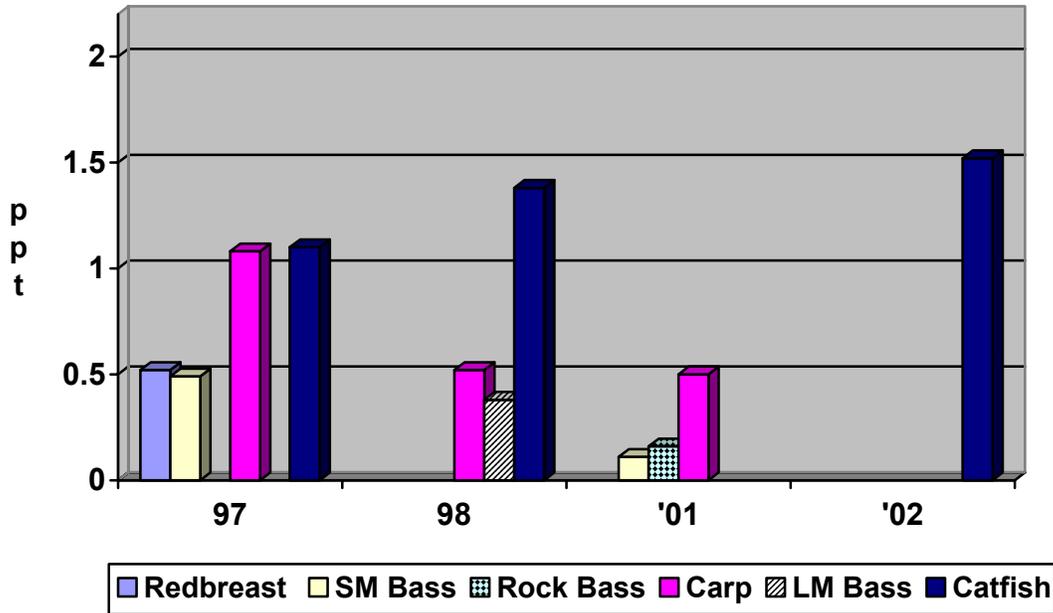


Figure 4: Fish tissue dioxin data from the Pigeon River at Tannery Island (1997-2002). Chart represents the highest dioxin value found in each species.



The fish tissue monitoring station at Tannery Island on the Pigeon River.

Photo provided by Jonathon Burr, WPC, KEAC.

Table 4: Fish tissue dioxin data from the Pigeon River at Tannery Island (1997-2002)

Year Collected	Species	Number of Fish	Average Weight (lb)	Dioxin (ppt)	Advisory
1997	Channel Catfish	5	1.2	1.10	Yes
1997	Carp	5	4.6	1.08	Yes
1997	Redbreast Sunfish	4	0.3	0.41	Yes
1997	Redbreast Sunfish	1	0.6	0.52	Yes
1997	Smallmouth Bass	1	3.2	0.49	No
1997	Smallmouth Bass	1	1.7	0.35	No
1997	Smallmouth Bass	3	0.6	0.33	No
1998	Channel Catfish	5	1.6	1.38	Yes
1998	Carp	5	6.2	0.52	Yes
1998	Largemouth Bass	4	1.7	0.38	No
2001	Carp	4	6.8	0.50	Yes
2001	Carp	1	12.0	0.20	Yes
2001	Smallmouth Bass	1	2.3	0.09	No
2001	Smallmouth Bass	3	1.3	0.11	No
2001	Smallmouth Buffalo	5	0.4	0.16	No
2002	Channel Catfish	6	2.0	1.52	Yes
2002	Channel Catfish	1	3.3	0.67	Yes
2002	Channel Catfish	1	3.2	0.02	Yes

Game Fish

The redbreast sunfish is the only species of game fish in the Pigeon River on the consumption advisory. At the time the advisory was issued, the redbreast sunfish was one of the most commonly encountered game fish. Since that time, the water quality in the river has improved to the point that native species are returning and a more balanced fish community exists. This has made it difficult to find mature redbreast for analysis. Redbreasts have only been collected one year between 1996 and 2001 (Figure 5). However, dioxin values were below 1 ppt at the two sites sampled.

Smallmouth bass and rock bass have replaced redbreast sunfish as the more commonly encountered game fish and have been collected for five consecutive years (Figure 6). These fish are also more likely to be consumed by the public in larger quantities than redbreast. Largemouth bass and spotted bass have also been collected periodically. None of these fish had dioxin levels exceeding 1 ppt. Based on these observations it appears that game fish from the Pigeon River, including the redbreast sunfish, are safe to consume.

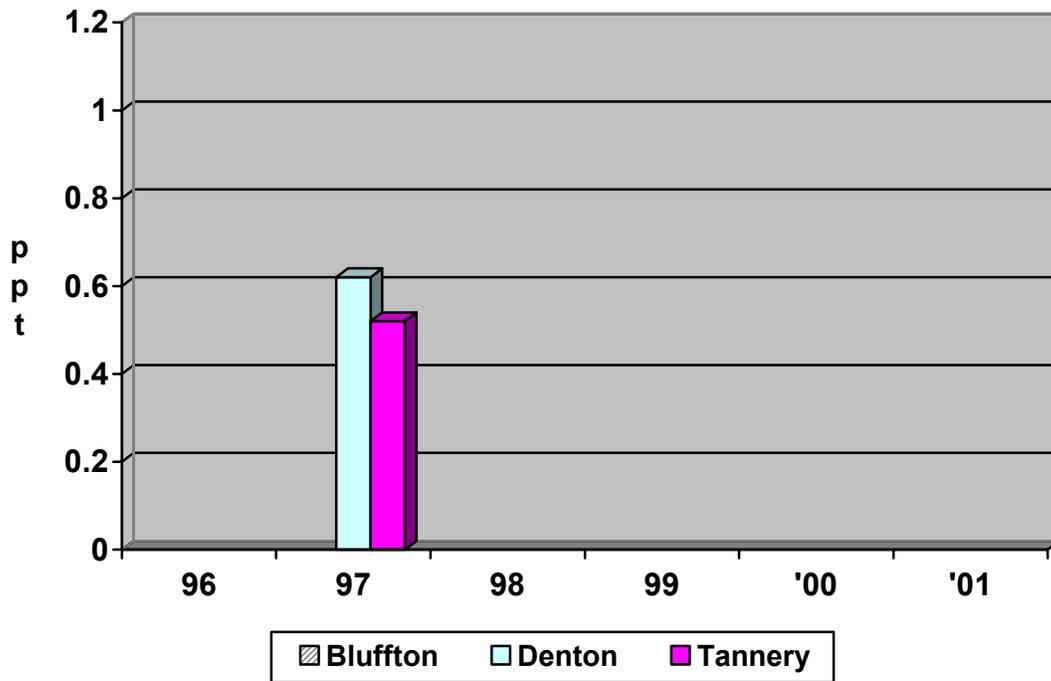


Figure 5: Red Breast Sunfish Dioxin Data from the Pigeon River (1996-2001). Chart represents the highest dioxin value found in each species.

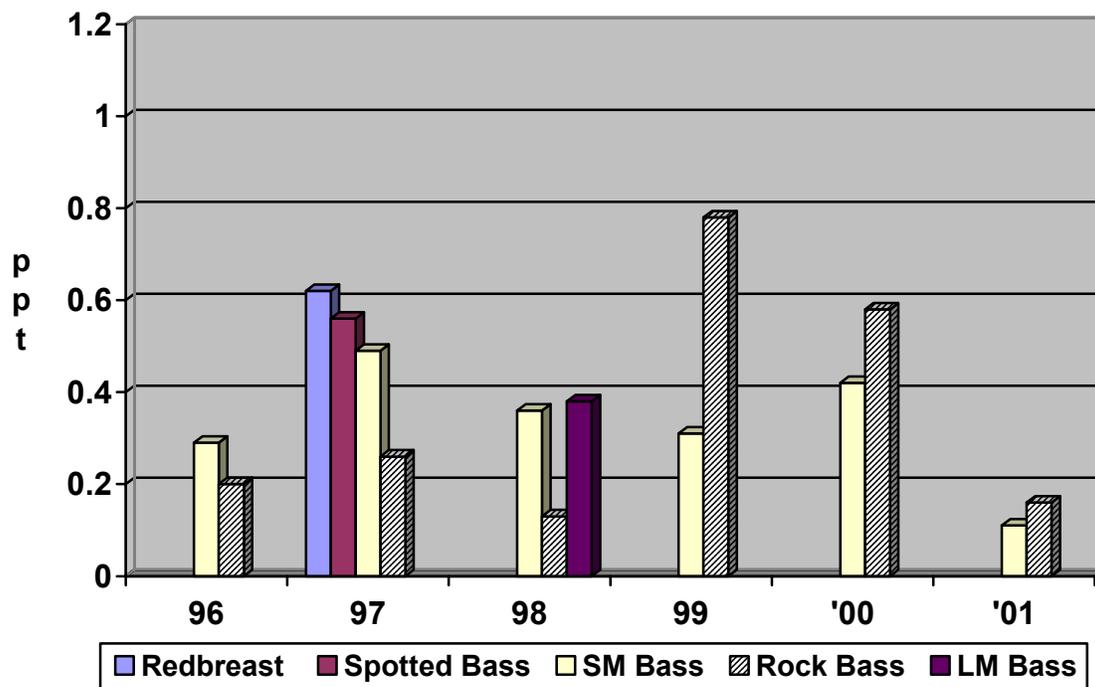


Figure 6: Game Fish Dioxin Data from the Pigeon River (1996-2001). Chart represents the highest dioxin value found in each species.

Rough Fish

Carp is the only rough fish in the Pigeon River on the consumption advisory. Dioxin levels have not exceeded 1.2 ppt for seven years, far below the 5.0 ppt posting standard (Figure 7). Three other rough fish species, smallmouth buffalo, northern hogsucker and black redhorse, have also been tested. These fish had low dioxin levels with no values exceeding 0.8 ppt (Figure 8). Based on these data, the rough fish species found in the Pigeon River appear safe to consume.

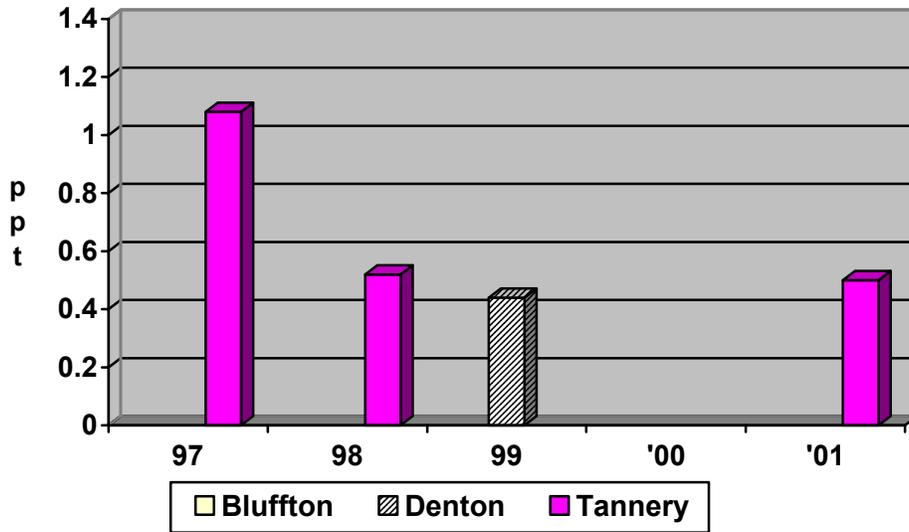


Figure 7: Carp dioxin data from the Pigeon River (1997 – 2001). Chart represents the highest dioxin value found in each species.

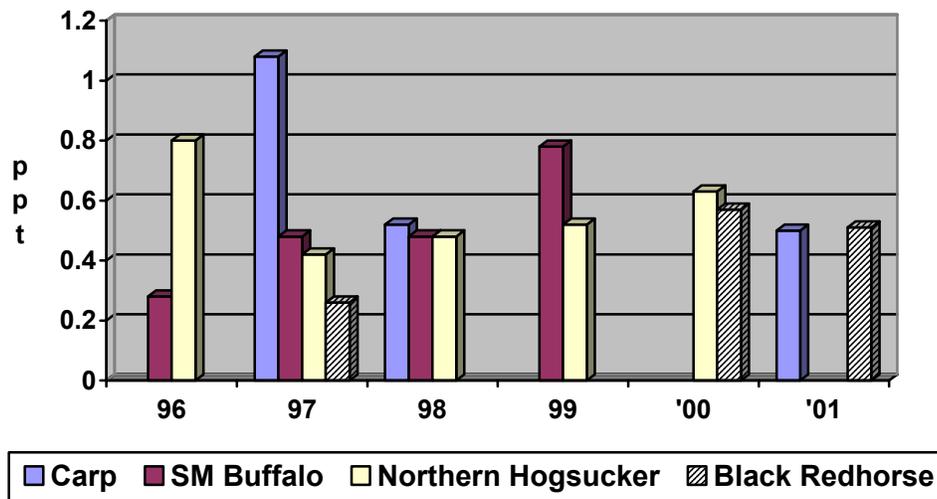


Figure 8: Rough Fish Dioxin Data from the Pigeon River (1996-2001). Chart represents the highest dioxin value found in each species.

Catfish

The Pigeon River is posted with a precautionary advisory for consumption of channel catfish. Catfish have the highest levels of any other tested species with values generally above 1.2 ppt. However, all samples collected since 1995 had dioxin levels well below the existing 5.0 ppt posting standard (Figure 9).

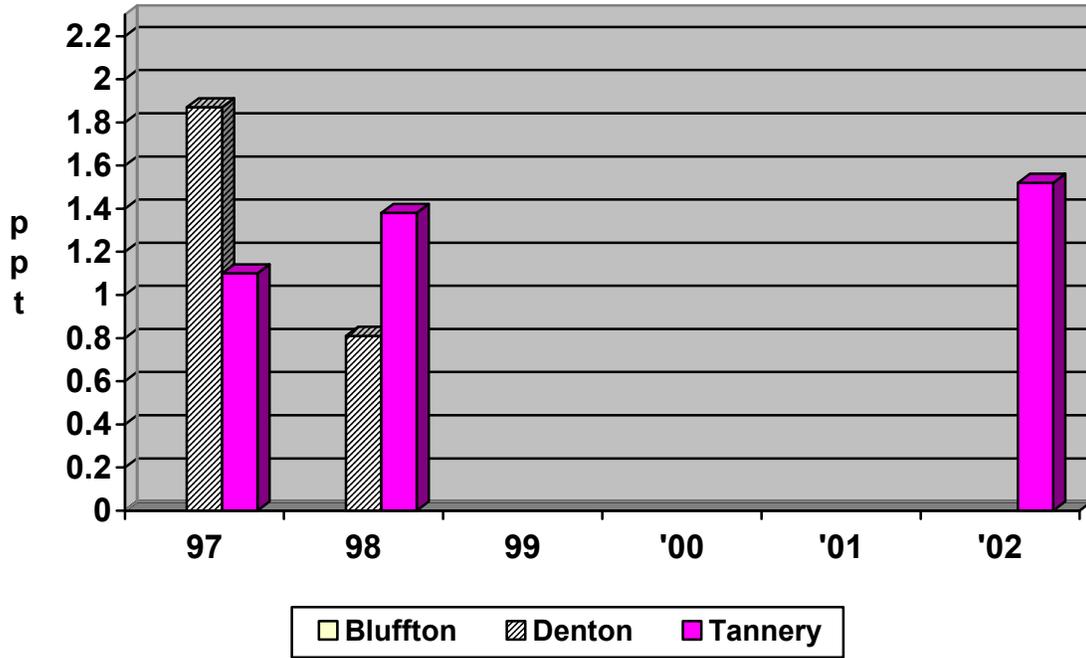


Figure 9: Channel catfish dioxin data for the Pigeon River (1997 – 2002).
Chart represents the highest dioxin value found in each species.



Channel Catfish

CONCLUSIONS

Multiple fish tissue samples collected from three sites on the Pigeon River since 1996 indicate that dioxin levels have decreased significantly since consumption advisories were established in 1989. The three species currently listed on the consumption advisory (redbreast sunfish, carp and channel catfish) were below both the 5.0 ppt posting level used by Tennessee and the 3.0 ppt posting level used by North Carolina. Other tested game fish and rough fish species also fell well below this level.

The highest levels of dioxin in Pigeon River fish continue to be documented in channel catfish. However, these levels are well below the current posting level. Additionally, channel catfish are not considered common in the Tennessee portion of the Pigeon.

Therefore, it appears that the fish in the Tennessee portion of the Pigeon River are safe to consume at normal consumption levels and the advisory should be lifted. It should be noted that the lifting of the fish consumption advisory will not have an effect on the other pollutants identified as impacting designated uses of the Pigeon River in Tennessee's 2002 303(d) List. Tennessee still considers the amount of color in the Pigeon River to be objectionable, especially in low flow conditions near the stateline.



Fish for tissue analysis are collected by a combination of backpack shocking (pictured), boat shocking, seining and gill netting.
Photo provided by Jonathon Burr, WPC, KEAC.

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